AGRICULTURAL CHEMICAL INPUTS IN SASKATCHEWAN *

Providing information to this group on the chemicals which are used in Saskatchewan agriculture seemed like a fairly easy task when I agreed to this assignment several months ago. I agreed readily because it is an area with which I have been associated for several years.

The job wasn't quite as easy as it looked at first. Yes, it was fairly easy to obtain the figures, although that took a bit of search and interpretation. The more difficult part was to incorporate them into a presentation which would hopefully be meaningful to you and others.

In order to do this it seemed necessary to go beyond a simple recitation of pounds, tons and gallons of chemicals - to somehow relate the chemicals to the environment which received them and to suggest some reasons why farmers use chemicals.

Let's look first at the environment of Saskatchewan and adjust our thinking if you will, so that we can appreciate the "chemical figures" that will follow.

The Saskatchewan agricultural area isn't large - it's huge! It is an almost uninterrupted block of about 43 million cultivated acres. Some 25 to 26 million are sown to annual crops, 15-16 million are in fallow and the balance is in cultivated forage. This means that a crop or problem confined to only 5 per cent of the seeded acreage involves over 1 1/4 million acres of land!

Less than one million people live in the province so most of the production, which contains nutrients drawn from the soil, is exported out of the province.

The province is in a semi-arid region and leakage of nutrients or soil additives downward in the soil is limited. Surface tillage, used by nearly all farmers, assures that added materials will be

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exposed to high populations of soil microflora, sunlight and weathering, also to erosion by wind and water.

Yields generally are low due to climatic restraints. While nutritive and protective chemicals are of considerable importance, the climate restricts economic use to a pretty narrow range.

There are a number of other factors which characterize the province and affect chemical use. Wildly fluctuating market opportunities reduce chemical use and cause it to vary a great deal from year to year. Insect "explosions" often encourage chemical use on an emergency basis, an example of which is the Bertha armyworm campaign in 1971.

Now for the chemicals. We'll start by dealing with those that I refer to as protective chemicals and then with the nutritive ones.

Protective chemicals - the herbicides, insecticides, fungicides, etc. do not increase crop yield. They simply allow crops to come as close as possible to achieving maximum yield and quality. Their use in Saskatchewan can best be described as intermittent and at low rates per acre.

Herbicides

2,4-D & MCPA Used in Saskatchewan (1)

Year	Amount (000 lbs.)	Acreage (x 000)	Avg. Rate/Acre (oz.)
1971	3,318	9,050	5.8
1970	2,591	7,031	5.9
1969	4,037	10,594	6.0
1968	6,286	17,398	5.8
1967	4,924	14,620	5.4
1966	5,417	16,165	5.4
1965	4,991	15,584	5.1
1964	4,012	11,401	5.6
1963	4,573	14,459	5.0

Looking at the Saskatchewan figures, it is noted that the acreage sprayed each year is generally less than the fallow acreage and averages out at about one-third of the 41 Mi. total acreage devoted

to annual crops. The average rate is therefore in the order of 2 to 3 oz. of phenoxy acid per acre per year.

The use of 2,4-D and MCPA in Saskatchewan probably accounts for one-half of the rise in average wheat yield from 15 bushels per acre before 1950 to over 20 bushels per acre in the last 20 years.

Looking further afield we note that the phenoxy compounds were used on 4 Mi. acres in the prairie provinces in 1948, 8 Mi. in 1949 and then 11 - 16 Mi. in each of the next 10 years. From 1960 to 1971 inclusive the acreage was in the 20 - 30 Mi. bracket with the exception of 1970 when just under 16 Mi. acres were sprayed.

Mixtures of bromoxynil octonoate, dicamba and dichloraprop with phenoxy compounds have been used since the mid-sixties, mainly because they are more effective in controlling weeds such as wild buckwheat, cow cockle and green smartweed. In Saskatchewan their use is estimated to be in the 100 - 200,000 pound bracket in each of the last five years, sufficient to do 200 to 400,000 acres at the 8 ounce rate per acre.

Barban, diallate and triallate came into use in the early 1960's for wild oat control. On the average 1 1/3 million prairie acres have been treated with one of the chemicals in each of the last five years with 1/3 to 1/2 of the acres being in Saskatchewan. Barban, commonly known as Carbyne is used post-emergence at 4 to 5 ounces per acre and Avadex or Avadex BW at 3/4 to 1 1/2 pounds per acre soil incorporated. The products are very rarely used in successive years on the same land and their use has been limited to land on which yields are likely to be severely reduced by wild oats.

Trichlorobenzoic acid or TCA and its sister compound dichlorobenzoic acid, dalapon are used in Saskatchewan for green foxtail control at 1 1/2 to 2 pounds per acre and 3/4 - 1 pound per acre respectively. In the last five years an average of 150,000 pounds of TCA have been applied on 100,000 acres. Dalapon during this period has averaged 40,000 pounds on 50-60,000 acres.

Broad-leaved weed control in rapeseed has always been a problem and in the last few years two products have been

introduced to counteract this problem, however neither one has to date achieved major acreage status.

Nitrofen, or TOK RM has been used for three years. It is a post-emergence spray applied at 1.2 lbs./acre. Treflan is soil incorporated generally at 1 lb./acre.

Fungicides

Records indicate that the only ones used in Saskatchewan agriculture are those applied as seed dressings to protect crops from seed rot and externally borne bunt or smut diseases.

The record on the extent of mercury used is far from complete, however the following should enable us to secure an adequate picture.

Mercury was an ingredient in some seed dressings in the province in the early 1940's and the use of these products increased rapidly toward the end of that decade. A survey in 1953 (2) indicated that 35.7% of the wheat, 41.5% of the barley and 26.5% of the oat acreage had been treated with mercury bearing compounds for disease control. From then till 1966 these compounds were used on about 35 to 40% of the seeded acreage each year. A decline in fungicide use, the advent of non-mercuries and reduced availability of mercury reduced the amount used in the last five years.

(3) During the 40-year period of use 60 to perhaps 120 tons of mercury were added to Saskatchewan soils as seed treatments. Even where the highest rates were used (.02 lbs./acre of mercury) on all annual crops produced, the total amount added was less than 1 oz./acre over the 40-year period. In view of the very small amount added and studies which suggest very low mobility in the soil, one wonders why the huge fuss about agricultural use of mercury ever developed. I can think of many more important issues to be concerned about.

The main argument for removing mercury from agricultural use is the health of the farmer and his hired help. I'm inclined to think that the 1.5 to 2% ethyl or methyl mercury seed dressing is less of a hazard to farmers than the quick silver we used for calibration or the "swabbing compound" we used to disinfect our bacteriology work benches as undergrads in these hallowed halls.

A host of other chemicals have been used for fungicidal purposes in seed dressings. Hexachlorobenzene has been the most widely used (in Bunt-no-more and Anticarie SD) but volumes have been much lower than mercury. Pentachloronitrobenzene and choranil are others. Captan, contained in rapeseed treatments, is increasing in use to control seedling blight and seed rot.

Systemic type seed treatments are becoming available and are likely to be used on those crops which do not have genetic disease resistance in the future.

Insecticides

Saskatchewan has been plagued by both large, short run insect infestations and by chronic, less dramatic but very destructive insect problems. As an example, estimates made by the Saskatchewan Department of Agriculture(4) placed total losses from sawfly, wireworms, cutworms and grasshoppers for the years 1950,51 and 52 at 47,58 and 50 million dollars respectively. Losses from these causes were estimated at $30 Mi. in 1954 and $33 Mi. in 1958. These are very sizeable and serve as strong incentives to farmers to combat insects in many different ways.

In 1950 grasshopper losses were estimated at $17 Mi. and the cost of the campaign was near $1 Mi. for materials alone. A cost/benefit survey in two rural municipalities revealed that in one of these $17 was realized from each dollar expended on grasshopper control and $41 in another.

(5) The large grasshopper campaign of 1948-51 used the following list of ingredients.

4,046 carloads of sawdust
5,159 carloads of millfeed
Sodium arsenite - 55,286 gallons
Sodium fluosilicate - 208,510 gallons
Chlordane - 275,000 pounds (3-4 oz./acre)
Aldrin - 225,000 pounds (2 oz./acre)

Ten years (1958-62) later another major grasshopper infestation was controlled with 1.5 million pounds of dieldrin used at 1 oz./acre

to treat over 24 million acres of land in the five-year campaign.

Cutworms occur nearly every year and on occasion are numerous. In 1962 a heavy outbreak occurred and 8-900,000 acres were sprayed with Endrin at 2-3 oz./acre, and 300,000 with Dieldrin at 4 oz./acre.

Seedling rapeseed stands have been attacked by fleabeetles and treated successfully with DDT at 10 oz. of material/acre. Infestations generally have been sporadic, often confined to the field edges and the total acreage treated in any given year has probably been under 20,000 acres. Crop rotation and the use of a seed treatment containing lindane has made it unnecessary to field spray large acreages for this insect. One -3 oz. of lindane/acre is used as a seed treatment on perhaps 1/3 - 1/2 of the acreage of rapeseed. Guthion, an organo phosphate is replacing DDT as a foliage spray for fleabeetles. DDT, once used for Bertha armyworm, was replaced by methomyl, more commonly known as Lannate, on about 750,000 acres of infestation in 1971.

Lindane and heptachlor are used as seed dressings to control wireworms in annual grain crops. The rate used is about 3/4 oz./acre on perhaps 10% of the land or 2.5 million acres annually.

Nutritive Chemicals or Fertilizers

I indicated earlier that Saskatchewan exports most of her grain production. I can add now that we export much more nutrients with the grain than we have ever returned to the soil in the form of fertilizer. I did some calculating on the 1971 crop and came up with the following figures.

Nitrogen extracted/acre of crop	=	50 lbs./acre
Added (as commercial fertilizer)	=	1.3 lbs./acre
Deficit	=	48.7 lbs./acre →

Phosphate extracted/acre of crop	=	13 lbs./acre
Added (as commercial fertilizer)	=	3 lbs./acre
Deficit	=	10 lbs./acre →

Perhaps it would be more impressive to cite the total pounds involved.

	lbs. Nitrogen	lbs. P_2O_5
Extracted	= 1,262,150,000	= 327,040,000
Added as fertilizer	= 33,160,800	= 74,095,800
Net deficit	= 1,228,889,200	= 242,944,200

Those are the figures gentlemen, despite the fact that farmers applied [6] 102,774 tons of an average 46% nutrient fertilizer to their fields in 1971. If this total amount had been used on the 7.2M acres of stubble crop it would have provided 4.6 lbs. of N, a grossly inadequate supply of that nutrient, and 10 lbs. of P_2O_5, about 70% of the requirement.

In the future we can expect to have 10 million acres of stubble and 15-16 million acres of fallow crop each year. In order to maintain fertility, i.e. replace one half of the N (25 lbs./acre) and all of the P_2O_5 Saskatchewan requirements will be:

370,000 tons/year of a 34% nitrogen fertilizer
and 312,500 tons/year of a 52% phosphate fertilizer.

Saskatchewan farmers have never come even close to providing this amount in any year and may not for some time. Failure to do so in the future can only result in a steady depletion of soil nutrients and inevitably lower yields.

Much has been said about organic farming - the returning of nutrients to the soil via manures and compost. Saskatchewan farmers probably do the best job of any I know in returning as much organic matter as possible right now - all we take off is the seed and there's just no way to retrieve that from wherever it goes. We can retrieve the nitrogen which ultimately finds its way into the air by converting it in fertilizer plants to inorganic nitrogen. But we cannot recapture the phosphates. They find their way through humans to sewage disposal systems and finally our lakes, streams and oceans from whence they are unlikely to ever be retrieved.

Concluding Comments

Saskatchewan is a huge, dryland farming area. Major crops are grown on millions of acres which leads to all kinds of problems of disease, insects, etc., however we have been able to live with these and still be a very efficient producer. While land use patterns in the future will change, they aren't likely to be made with the idea of effecting disease or insect control. That's about as practical as dispersing New York city residents to effect flu control. Rather I think we will continue to rely on our chemists, plant breeders and agronomists to provide us with means to overcome problems while keeping pollution to a very minimum.

On the plant nutrition side I think we will have to rely on fertilizers bought by the bag, ton or gallon to maintain fertility and yield. Legumes are likely to be used more, however they will not do the complete job. Neither will "organic farming" as espoused by the more naive. I hope someday we can stop the urban sector from polluting "rural" waterways with domestic sewage. While this would not overcome all of our soil fertility problems, at least it would help to make Saskatchewan a nicer place to live.

References

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2. "The Saskatchewan Seed Drill Survey, 1953." Plant Industry Branch, Saskatchewan Department of Agriculture, Regina.

3. Information Obtained from Occupational Health Branch, Department of Public Health, Regina.

4. Annual reports, Plant Industry Branch, Saskatchewan Department of Agriculture, Regina.

5. Annual Report, March, 1952, Plant Industry Branch, Saskatchewan Department of Agriculture, Regina.

6. "The Fertilizer Trade In Canada," Year Ended June 30, 1971. Statistics Canada, Ottawa.